SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JUNE 21, 1907

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LINNÆUS AS A ZOOLOGIST[1]

CAROLUS LINNÆUS, later known as Carl von Linné, was born at Roeshult, in the province of Smaland, Sweden, May 13, old style, 1707, and died at Hammerby, near Upsala, on January 10, 1778. His grandfather was a farmer; his father, a clergyman. Young Linnæus, the future naturalist, was intended by his parents for the ministry, and his early education was conducted with this end in view. At the age of ten, he was sent to the Latin school at Vexio, but after seven years at this school he was found to be so deficient in his scholastic studies that his parents thought of apprenticing him to a shoemaker.

While at Vexio, much of his time was devoted to the study of plants and insects, an inclination apparently favored by his master, who was himself greatly interested in botany. Fortunately young Linnæus was rescued from his threatened degradation by Dr. John Rothman, a physician of Vexio, who recognized his superior abilities and appreciated his interest in natural history. He took him into his own home, where for a year Linnæus continued his botanical studies, aided by the advice and library of his patron. At the age of twenty he entered the University of Lund, where he soon found himself without means of support, through the death of his patron and friend, the kind-hearted physician of Vexio. Fortunately he soon won the friendship of Dr. Kilian Stobæus, the pro-

[1] Read at the exercises of the New York Academy of Sciences in commemoration of the two hundredth anniversary of the birth of Linnæus.

fessor of botany and medicine, who made him a member of his family. Here he had access to books and to a small museum of natural history, and found much leisure for exploring the neighboring country and for collecting objects of natural history. At the end of a year he went to Upsala, where, under Rudbeck and Roberg, he advanced rapidly in medicine and botany. Here he won the friendship of the renowned Olaf Celsius, whom he later characterized as the best botanist in Sweden, and of Artedi, a fellow student, who afterwards became the founder of ichthyology. During his whole course at Upsala, it is said that he did not hear a single public lecture on either anatomy, botany or chemistry, but he and Artedi, in good-tempered rivalry, were devoting their energies to natural history, Linnæus to plants, birds and insects, and Artedi to amphibia and fishes. Linnæus here also began the preparation of his epoch-making works on botany and of the first edition of his 'Systema Naturæ,' published a few years later in Holland.

In 1732, at the age of twenty-five years, he was commissioned by the Upsala Academy of Sciences to make a tour of exploration in Lapland in the interest of natural history. He left Upsala on the twelfth of May, and after an absence of five months returned to Upsala on the tenth of October. This remarkable journey of 4,600 miles was made partly on horseback, partly by boat and partly on foot; it extended northwestward across the Norwegian Alps to the coast of Norway beyond the Arctic Circle; the return journey was made by way of eastern Finland. It was an undertaking of great hardship and much danger, being performed alone, aided only by local guides employed to conduct the way from one point to another. On his return a report of his journey was presented to the academy, but it remained in manuscript until translated and published in English by Dr. James Edward Smith, the first president of the Linnæan Society of London, in 1811.[2] The botanical results, however, were published separately by Linnæus himself, in 1737.

The following year was spent at Upsala, where he attempted to eke out his scanty means of support by giving lectures on botany, mineralogy and chemistry. This proved contrary to one of the statutes of the university, to the effect that no one should give public lectures who had not obtained his doctor's degree, which statute was invoked against him by Rosen, the successor to Rudbeck in the professorship of medicine and anatomy, who was jealous of Linnæus's abilities and attainments. Deprived of this financial resource, he took some of his pupils on excursions into the neighboring mountains, where he met the governor of the province of Dalecarlia, who sent him to explore and report on certain copper mines in which he was interested. While on this journey he gave lectures at Fahlun on mineralogy and assaying. Here he made the acquaintance of Dr. Moræus, a learned and wealthy physician of the district, and his two daughters, to one of whom he became betrothed; the father, however, insisted on deferring the marriage till Linnæus had completed his professional studies and obtained his medical degree. For this purpose, in the spring of 1735, he jour-

[2] The herbaria, library (about 2,500 volumes), manuscripts and correspondence of Linnæus were offered by his widow and daughters, 'by the advice of friends,' to Sir Joseph Banks, 'for the sum of a thousand guineas'; Sir Joseph, not feeling inclined to the purchase, recommended it to the consideration of his friend Doctor (later Sir) J. E. Smith, by whom these treasures were secured and transferred to England (Turton, 'Life and Writings of Linnæus,' 1806, p. [39]), and later passed into the possession of the Linnæan Society of London, founded in 1788 through the efforts of Dr. Smith, who was its first president. (See Jardine's 'Naturalist's Library,' Vol. I., 1833, p. 58.)

neyed to Lubek and Hamburg, and later to Holland, where, in June, he received from the University of Harderwyk the degree of doctor of medicine. At Leyden he became acquainted with the leading men of science of that city, which soon led to his engagement by Dr. George Cliffort, a wealthy burgomaster of Amsterdam, to take charge, at a liberal salary, of his extensive museum and botanic garden. Later he was sent by him to England to secure rare plants for his garden, with a letter of introduction from the great Boerhave to Sir Hans Sloane. He thus came in contact with the botanists of London, where, however, his reception was not always cordial.

On his return to Holland he was offered the position of government physician to the Dutch colony in Surinam, which he prudently declined, and became an assistant to his friend Van Royen at the botanic garden in Leyden. After a brief visit to Paris, he returned to Stockholm in September, 1738, where he determined to settle as a physician. Notwithstanding his fame abroad and his skill as a botanist, the pecuniary returns from his profession were at first small, but they gradually increased, and, obtaining some government patronage, his marriage to Miss Moræus was celebrated on June 26, 1739.

He remained only three years in Stockholm, during which period he helped to found the Royal Academy of Sciences of that city and served as its first president. In 1741, under an order from the government, he made a journey through Öland and Gothland. In the same year, he was called to the chair of botany at the University of Upsala, a position to which he had long aspired and which he filled for thirty years, when impaired health compelled him to resign his official duties and to discontinue his literary labors. The University of Upsala, through the fame of Linnæus, became widely renowned as a seat of learning, and attracted students from various parts of Europe. During these years of almost uninterrupted activity, most of Linnæus's numerous botanical and other works were published, the material for which reached him in ever-increasing abundance, not only from distant parts of Europe, but from Siberia, China, India, Egypt, South Africa and North and South America.

Academic honors were showered upon him by all the learned societies of Europe; a gold medal was struck in his honor by the nobles of Sweden, and in 1757 he was created by King Frederic a Knight of the Polar Star and admitted to hereditary nobility. Foreign courts made overtures for his presence, and his own country neglected no opportunity to do him honor. His death in 1778, after six years of invalidism resulting from an attack of apoplexy, was recognized as a national calamity; the University of Upsala went into mourning, and the king ordered a medal to be struck in his memory.

Although cramped by poverty during the earlier part of his career, prosperity did not long withhold her smile; not only were the nobles of his country his patrons, but he was an especial favorite of both King Frederic and his queen. Through various emoluments showered upon him he was able, later in life, to purchase a large estate and to construct for himself a museum, wherein he gathered the largest collection of botanical treasures that at that time had anywhere been brought together. He was happy in his domestic relations, and lived to see his son succeed to his chair at the University of Upsala.

Although Linnæus's publications relate mainly to botany and medicine, they cover the whole realm of natural history. His earliest contribution to science is generally considered to be his 'Florula Lapponica,' the first part of which appeared in the

Transactions of the Swedish Academy in 1732.[3] This was followed by the first edition of his 'Systema Naturæ,' published in Leyden in 1735. The 'Fundamenta Botanica' followed in 1736, and was later enlarged and republished as the 'Philosophia Botanica,' in 1751. During the next ten years various other botanical publications appeared in rapid succession. His 'Fauna Suecica,' published in 1746, was his first special work relating to zoology. It is also notable as being the first work especially devoted to the entire fauna of any country. It was republished, with many additions, in 1761. Other botanical and several medical works followed during the next seven years, including his monumental 'Species Plantarum,' published in 1753. In the same year also appeared the 'Museum Tessianum,' consisting chiefly of descriptions of minerals and fossils, the latter mainly shells and corals, and in 1754 the 'Museum Adolphi Friderici,' relating exclusively to exotic animals. This was a folio with 33 plates, the most extensive and most elaborately illustrated of all of Linnæus's works. Two important medical works appeared in 1760, and his third zoological work, the 'Museum Ludoviciæ Ulricæ,' in 1764, a thick octavo, to which was annexed the second part of the 'Museum Adolphi Friderici.'

During these thirty years of marvelous scientific activity, Linnæus also contributed many papers to the transactions of the Upsala and Stockholm Academies and to the 'Amœnitates Academici.' The latter, in ten octavo volumes, consists of dissertations or academical theses, mostly by his students, selected, edited and published by him, and thus may be regarded as of equal authority with his own writings. Seven of these volumes were published during his lifetime and contain a number of his own minor papers.

This brief outline of Linnæus's life, his opportunities, and the published results of his scientific labors, affords the basis for the consideration of Linnæus as a zoologist. As has been shown, he was primarily a botanist; he was also a mineralogist, an entomologist and a conchologist, but only incidentally a vertebrate zoologist. In this field his interest was less strong, his opportunities for research the most restricted. His zoological writings, exclusive of a few minor papers, are comprised in the 'Fauna Suecica,' the 'Museum Adolphi Friderici,' the 'Museum Ludoviciæ Ulricæ' and the several editions of his 'Systema Naturæ.' The first edition, appearing in 1735, was a folio of only 12 pages, consisting merely of a conspectus of his 'Systema,' in tabular form. The second edition, published in 1740, was an octavo of 40 pages, in which were added, for the animal kingdom, the characters of the groups. The sixth, published in 1748, was greatly enlarged, the zoological part alone consisting of 76 pages, illustrated with six plates, or one for each of his six classes of animals. The tenth, published in 1758, was in two octavo volumes, of which the zoology formed the first volume, consisting of 824 pages. The twelfth, and the last edition revised by the author, was issued in three volumes, the first of which, containing the zoology, and comprising 1,427 pages, appeared in 1766. Thus in thirty-three years this work grew from a brochure of 12 pages to a work of 2,400 pages.

The first edition of the 'Systema' was published when the author was only twenty-eight years old, during his sojourn in Holland; he had never previously been beyond the confines of southern Sweden, except on his journey to Lapland and Finland in 1732, and he had had access to no large

[3] His 'Hortus Uplandicus' is said to have appeared one year earlier. See 'List of the Works of Linnæus,' in Jardine's Naturalist's Library, Vol. I., 1833, p. xvii, foot-note.

collection of animals. Thus his resources for such an important undertaking were extremely limited, being restricted to his own considerable first-hand knowledge of the fauna of Sweden, to the few specimens of exotic animals he had been able to see in Lund, Upsala and Stockholm, and to the scanty literature of the subject there available. When the second edition appeared, in 1740, he had spent less than three years and a half in foreign countries, mainly in Holland with single brief visits to London and Paris, but his interests on these occasions were botanical and not zoological.

The sixth edition (the third revised by the author), published in 1748, was in effect a synopsis of the fauna of Sweden, filled in, as regards the fauna of the rest of the world, by compilations from his predecessors. Strange as it may seem, outside of the tropical genera *Simia, Bradypus, Dasypus, Myrmecophaga* and *Manis,* this edition enumerates only thirteen species of mammals not found in Sweden. Only 140 are recorded for his whole class 'Animalium quadrupedium,' one third of which are Scandinavian.

This analysis could be extended to other classes with practically similar results. The class Insecta, for example, includes only 13 species that are not also recorded in the 'Fauna Suecica,' showing how limited was his knowledge of the world's fauna at 1748.

The tenth edition (the fourth revised by the author), published in 1758, is *the* epoch-making work in the history of zoology, as in this the binomial system of nomenclature for the whole animal kingdom is introduced for the first time. The work is also greatly enlarged, and the classification greatly improved, especially that of the mammals, which class is now for the first time aptly designated Mammalia. The ordinal term Primates is substituted for Anthropomorpha of the sixth and previous editions, the sloths (genus *Bradypus*) are removed from it, the genus *Lemur* is added, as a new genus, and the bats are transferred to it from the Feræ. A new order, Bruta, is made up of his former third order Agriæ, now suppressed, and of such other extremely heterogeneous elements as the elephant, the manatee, sloths, anteaters and the scaly anteaters. The order Feræ consists of six properly associated genera; the armadillos, insectivores and bats, formerly included in it, being removed elsewhere. His fourth order, Bestiæ, is a new group, composed of the pigs, armadillos, opossums and insectivores. The fifth order, Glires, is a natural group, except for the inclusion of the genus *Rhinoceros,* now most strangely placed with the squirrels and mice. His sixth order, Pecora, is retained as in the previous editions, and is also a natural group. The seventh, Belluæ, is a new ordinal group, consisting of the genera *Equus* and *Hippopotamus,* transferred from the here disrupted order Jumenta of previous editions. The Cete, now removed by him from the fishes, form his eighth and last order. This reconstruction of the ordinal groups is a great improvement; five new genera are added, two old ones eliminated, and the number of species is increased from 140 to 185. In some of the other classes there are similar radical changes, but there is not time to refer to them.

The twelfth, and the last edition revised by the author, published in 1766, shows many improvements over the tenth. It is greatly increased in bulk through the addition of many new genera and a large number of new species. The classification is also judiciously modified at many points. Taking again the class of mammals for illustration, the number of orders is reduced from eight to seven, through the suppression of the grossly unnatural order Bestiæ and the transference of its genera to other associations, with, however, the

retrograde change of placing the insectivores and the genus *Didelphis* among the Feræ. The Glires are modified by the removal of the genus *Rhinoceros* to the order Belluæ, and the addition to it of *Noctilio*, a genus of bats. The order Bruta is the same incongruous association of elephants, manatees, sloths and anteaters as in the tenth edition.

The orders of mammals, as now left, correspond in several instances very nearly with those of our modern systems, notably the Primates, Glires, Pecora and Cete. The Feræ of the tenth edition corresponds to the modern Carnivora, but in the twelfth he made the mistake of putting back into it the marsupials and the insectivores. His order Belluæ being essentially the modern suborder Perissodactyla, his order Bruta is the only grossly incongruous association of types.

The only previous classification of mammals with which Linnæus's need to be compared is Ray's, published in 1693, whose system, taken as a whole, is far more artificial than Linnæus's. Naturally there are some striking coincidences of grouping, and in the characters employed by the two authors. As to the latter, Ray so well covered the field that there was little left for Linnæus to add, since during the interval between Ray and Linnæus not much was learned about the anatomy and relations of the ordinal groups of mammals. Doubtless Linnæus was influenced, in his removal of the cetaceans from the fish to the mammal class, by the systems of his contemporaries, Klein (1751) and Brisson (1756), in which respect only are their systems better or less artificial than his. Inasmuch, however, as Brisson divided mammals into eighteen orders instead of seven, he escaped some of the grotesque combinations made by Linnæus; on the other hand, he gave undue emphasis to relatively unimportant differences.

Linnæus's classification of birds is closely modelled upon that of Ray, and his departures from it are seldom improvements. His lack of knowledge of ornithology is strikingly apparent through his repeated association of very unlike species in the same genus, as where a penguin is combined with a tropic-bird to form his genus *Phaëthon*, and another species of penguin with an albatross to form his genus *Diomedea*. In the tenth edition, he recorded only about 550 species of birds; in the twelfth, this number was raised to nearly a thousand, mainly on the basis of Brisson's great work, which appeared in 1760. The greater part were based on the writings of previous authors; probably less than one fourth of them being known to him from specimens.

His class Amphibia contained four orders, of which the fourth consisted of cartilaginous and other wholly unrelated fishes, and shows how slight was his acquaintance with the lower classes of vertebrates. His first order, Reptilia, includes such diverse animals as turtles, lizards, salamanders, frogs and toads. The snakes formed his second order Serpentes.

His arrangement of the fishes was originally based on that of Artedi, whose 'Ichthyologia' Linnæus published while sojourning in Holland in 1738, after Artedi's untimely death by accidental drowning.

His class Insecta is nearly equivalent to the modern subphylum Arthropoda, as it includes the Arachnida and the Crustacea.

His class Vermes was the waste-basket of his system, including all the forms of animal life that were neither vertebrates nor insects, which he distributed into five orders, some of them as heterogeneous in character as the class itself. The second order, Mollusca, comprised all sorts of soft-bodied animals, mostly marine, as slugs, sea-anemones, ascidians, holothurians, cuttlefishes, starfishes, sea-urchins and jelly-

fishes. The animals now commonly known as Mollusca formed his third order Testacea.

It is not, however, just to judge Linnæus's work by the standards of to-day. The above comparison of the zoological part of the 'Systema Naturæ' with our present knowledge of animals is not to be taken as a disparagement; we merely note the progress of zoology during the last century and a half of the world's history. Linnæus was a born systematist; his energy and industry were enormous; his isolation promoted independence and originality. He devised new classifications, and thoroughly systematized not only the knowledge of his predecessors, but the vast increment he himself added. He inspired his students with his own enthusiasm, taught them his own advanced methods, and influenced a goodly number of them to undertake natural history explorations in distant and zoologically unknown parts of the world.

In special lines of research he was far behind several of his contemporaries, notably Brisson in respect to both mammals and birds. But he nearly doubled the number of known forms of reptiles, amphibians and fishes, and increased many fold the number of species of cœlenterates, on the basis of wholly new material gathered through his own efforts.

Disgusted with the needlessly detailed accounts and repetitions that characterized the writings of most of his predecessors, he unfortunately adopted the extreme of condensation, thereby adding greatly to the difficulties of his successors in determining to just what forms the thousands of new names he introduced really belonged. Many of his species, based on the accounts given by previous authors, were also composite, often containing very diverse elements. But this detracts little from his credit. As one of his appreciative biographers has tersely put it: "He found biology a chaos; he left it a cosmos."

Linnæus's beneficent influence upon biology was hardly less as a nomenclator than as a taxonomist. He not only invented a descriptive terminology for animals and plants, but devised a system of nomenclature at once simple and efficient, and which for a hundred and fifty years has been accepted without essential modification.

Linnæus divided the three kingdoms of nature into classes, the classes into orders, the orders into genera, the genera into species, under which latter he sometimes recognized varieties. Of these groups, as he understood them, he gave clear definitions, but they were in most cases much more comprehensive than the limits now assigned to groups of corresponding rank. His genera correspond in some cases to groups now termed orders, and frequently to the modern idea of family; in some cases they contained species now placed in separate orders. Prior to Linnæus, these groups had less definite significance, and were often designated by a phrase instead of a single word. Species were indicated only by a cumbersome diagnosis, intended to express their chief distinctive characters. For this Linnæus substituted a single word, an innovation the merits of which were at once almost universally recognized. But Linnæus reached this solution of a grave inconvenience somewhat slowly, and not till 1753 did he fully adopt the *nomen triviale*, when he introduced it into botany in his 'Species Plantarum,' which is taken by botanists as the point of departure for the binomial system. In the following year, 1754, he introduced it into zoology, using it throughout his 'Museum Adolphi Friderici' for all the animals catalogued or described in this superb work, namely, 39 species of mammals, 23 of birds, 90 of reptiles and amphibians, 91 of fishes and 64

of invertebrates, or for an aggregate of 307 species of animals. Four years later, in the tenth or 1758 edition of his 'Systema Naturæ,' he adopted it for the whole animal kingdom, which date is now generally taken as the beginning of the binomial system for zoology. The importance and utility of this simple innovation in a matter of nomenclature are beyond estimate, and if Linnæus had done nothing else for the advancement of biology he would be entitled to a conspicuous niche in the temple of fame and to the gratitude of all subsequent workers in this field. He for the first time gave technical standing to the systematic names, both generic and specific, of all the plants and animals known at the dates when he introduced the *nomen triviale* into the nomenclature of botany and zoology.

It is of interest in this connection to note the number of species of animals known to Linnæus at the date of publication of the last edition of the 'Systema Naturæ,' the number known to him personally, and the number recorded respectively from North America and from South America.

Of mammals, the whole number of species recorded is 190, of which three fourths are based on the descriptions of previous authors. Only 48 were American—12 from North America and 36 from South America. The five North American mammals known to Linnæus from specimens were the raccoon, star-nosed mole, common mole, flying squirrel and chipmunk. The number of species at present known from North America is 600, excluding subspecies. The number for the world, including the extinct as well as the living, is about 10,000, as against less than 200 recorded by Linnæus.

Of birds about 925 are recorded of the 15,000 known to-day. The 200 known from America are divided about equally between North America and South America, only 50 of which were described from specimens.

The amphibia and reptiles number collectively about 250, of which about one third are American, 40 per cent. of the latter being North American and 60 per cent. South American. The North American include three salamanders, the box-turtle, the six-lined lizard, the blue-tailed lizard and 14 snakes. The greater part of the 20 North American species of reptiles and amphibians known to him personally were based on specimens transmitted by his former student, Dr. C. D. Garden, from the Carolinas, and on a few sent from Pennsylvania by Peter Kalm, also one of his students. Thus the greater part of the snakes of the eastern United States became known to Linnæus prior to 1766.

About 500 species of fishes are recorded, of which 100 are American, divided about equally between North and South America. Forty of the nearly 60 North American species described are based on specimens sent from the Carolinas by Dr. Garden, the others mainly on specimens in the museum of King Frederic.

There is not time to notice in detail the various classes of Cœlenterates. A few words about insects will serve as a general illustration for this phylum. Linnæus recorded about 2,400 species, the greater part of which he was the first to describe. About 300,000 are now recognized. Of the insects known to him, 65 per cent. are recorded in the second (1761) edition of his 'Fauna Sueccia,' and many of the remainder are European, so that his knowledge of exotic species was exceedingly restricted. Of Coleoptera he recorded about 800 species; the number now known is estimated at 12,000. Of Lepidoptera he recorded about 800; 7,000 are now known from North America alone. Of Diptera he recorded 278 species, of which 200 were from Sweden; 12,000 are now known from North America.

Linnæus's system of classification was based on a few external characters, and

was recognized by himself as artificial and provisional. It was intended only as a stepping-stone to better things, when the structure and affinities of animals should become better known. The statistics already given indicate how limited was his knowledge of the world's fauna; his classification of animals shows how little he knew of their structure, and how often he was misled by superficial resemblances. Yet his 'Systema Naturæ' was the working basis of all naturalists for the next half century;[4] twelve editions were published during his lifetime, and it was later translated into several of the continental languages. To such an extent was it regarded as final by many subsequent naturalists that when his groups began to be changed and new genera interpolated it was deemed by some of them little less than sacrilege. When convenience demanded subdivision of the larger genera, owing to the great number of new species that had become known since 1766, it was quite common to consider the new groups as 'sections,' and to give them merely vernacular names, or, if their authors were bold enough to designate them by Latin names, they were commonly called subgenera.

It was not till near the close of the eighteenth century that there arose a new class of naturalists, the anatomical school, led by the elder Geoffroy and G. Cuvier, who studied the internal structure of animals as well as their external parts. It was, however, many years before the new systems began to displace or greatly to modify the long-accepted and strongly intrenched Linnæan methods of grouping animals.

The great advance in biologic knowledge since the time of Linnæus can not be easily measured; it can be suggested by noting the fact that comparative anatomy, embryology, histology, paleontology, evolutionism and many kindred lines of research have nearly all had their origin or principal development within the last century, all converging for the solution of the genetic relationships of animals and the origin of life. Linnæus, in an oration delivered in 1743,[5] held that each species of animal originated from a single pair, citing as incontrovertible proof the Mosaic account of the creation. It is indeed a long look back to the middle of the eighteenth century when his labors marked a new era in the history of biology. In commemorating to-day the two-hundredth anniversary of his birth, we honor ourselves by showing our esteem for the greatest naturalist of the eighteenth century.

J. A. ALLEN

[4] Turton, in his 'Life and Writings of Linné,' says: "To this system may be justly applied the nervous observations of Dr. Johnson, in his delineation of the character of Shakespeare. 'The stream of time, which is continually washing away the dissoluble fabrics of other systems, passes without injury by the adamant of Linné.'" —William Turton, 'A General System of Nature' * * * by Sir Charles Linné, Vol. VII., 1806, p. [42].

[5] In his oration 'De telluris habitabilis incremento,' delivered and first published in 1743 and republished in 1744, and again in the second volume of the 'Amœnitates Academicæ' in 1751, he gives his reasons for believing: "That at the beginning to the world, there was created one single sexual pair of every species of living thing.

"To the proofs of this proposition," he continues, "I request those who are my auditors to lend a favourable ear and willing attention.

"Our holy Faith instructs us to believe that the Divinity created a single pair of the human kind, one individual Male, the other Female: The sacred writing of Moses acquaint us that they were placed in the Garden of Eden, and that Adam there gave names to every species of animal, God causing them to appear before him.

"By a sexual pair I mean one male, and one female in every species where the individuals differ in sex: * * *—J. F. Brand's translation, in 'Select Dissertations from the Amœnitates Academicæ,' 1781, pp. 75, 76.

SCIENTIFIC BOOKS

Hydrates in Aqueous Solution. Evidence for the existence of hydrates in solution, their approximate composition, and certain spectroscopic investigations bearing upon the hydrate problem. By Harry C. Jones, with the assistance of F. H. Getman, H. P. Bassett, L. McMaster and H. S. Uhler. Pp. viii + 264. Publication No. 60 of the Carnegie Institution, Washington, D. C., 1907.

The first part of this monograph, covering 157 pages, presents the detailed results of earlier work and the measurements of Getman and Bassett of freezing-points, electrical conductivity, specific gravity and refractive power of solutions. All the observations were made on aqueous solutions, except a series of determinations made by McMaster, presented on pages 149 to 152, which relate to solutions of lithium chloride, bromide and nitrate in methyl and ethyl alcohol and to calcium nitrate in the latter solvent. In the case of the aqueous solutions, 98 compounds, including acids, salts and bases were studied; and in the course of this work between 1,400 and 1,500 solutions were examined. The purpose of making the specific gravity determinations was merely to permit a computation of the lowering of the freezing-point per 1,000 grams of solvent, the solutions having been prepared by dissolving a certain weight of substance in water and then diluting to a definite volume.

The refractive indexes when charted as ordinates against the concentration of the solutions as abscissas yield curves which are practically straight lines in all cases. They consequently bear no simple relation to either the conductivity or freezing-point curves, and are, indeed, not used later in the argument concerning hydrates in solution.

The electrical conductivities of the solutions were measured for the purpose of ascertaining the so-called degree of electrolytic dissociation of the dissolved substances. When the molecular conductivities are charted as ordinates and the corresponding volumes as abscissas, smooth curves are obtained in all cases. These curves have in general a similar trend, being concave toward the axis of abscissas for the various electrolytes investigated.

The ebullioscopic method was employed in but few of the aqueous solutions; the alcoholic solutions were, of course, investigated by this method. On the other hand, the cryoscopic method was very extensively employed in studying the aqueous solutions, and in order to make comparison possible, the electrical conductivity measurements were made at 0° C. When the molecular lowerings of the freezing-point are charted as ordinates and the molecular concentrations as abscissas, curves are obtained which are in general convex toward the axis of abscissas. In some cases the points of inflexion are quite well defined, in other cases the curves are fairly flat, and in still others they are nearly straight lines. In the few cases where boiling-point curves have been similarly charted, these show the same general behavior, except that the points of inflexion occur at a greater concentration than in the freezing-point curves.

The chief argument presented in the monograph for the existence of hydrates in solution is the occurrence of minima in these freezing-point and boiling-point curves. From the fact that the minima occur at higher concentrations in the boiling-point curves, it is argued that the hydrates are less stable at higher temperatures and hence require greater concentration for their formation than at lower temperatures. To be sure a point is also made of a supposed relation between lowering of the freezing-point and water of crystallization of the dissolved substance, it being claimed that high crystal water content and a large depression of the freezing-point go together. As a matter of fact, however, the behavior of solutions of many salts rich in crystal water speaks strongly against this supposed relation. So for instance, the sulphates in general give relatively small lowerings of the freezing-point, a fact which, moreover, is not new. This behavior of the sulphates it is stated is 'abnormal' and due to polymerization of the salts. However, no independent evidence is adduced to support the assumption that such polymerization occurs, and so the relation which it is claimed exists between lowering of

the freezing-point and crystal water content of the solute can not be considered as established. The well-known fact that salts generally separate from hot solutions with less water of crystallization than from cold solutions is also regarded as evidence of the existence of hydrates in solution.

The fact that salts frequently crystallize with water has long been considered as evidence in favor of the assumption that hydrates exist in solution. The reasoning has simply been that whatever separates from a solution at a given temperature has also existed in that solution. So in this respect the paper really presents nothing new. Furthermore, it has long been known that the various physical properties of solutions can not be foretold on the assumption that solutions are merely mechanical mixtures of solvent and solute. The deviations which the properties of solutions have shown from those computed on the assumption that they are merely mechanical mixtures have always been regarded as evidence in favor of the idea that in the process of solution some form of combination between solvent and solute takes place; and so the argument in favor of the existence of hydrates in solution based upon the occurrence of minima in the freezing-point curves also presents nothing new in principle. However, there has been in the past great difficulty in determining definitely just what the composition of the supposed hydrates in solution really is, and as Professor Jones presumes to compute, at least approximately, the composition of these hydrates, the vital interest of the whole monograph really centers upon the results of these computations.

Now an inspection of the method adopted by the author for determining the approximate composition of the hydrates in solutions shows that it consists of assuming the approximate validity of the simple gas laws for all solutions, concentrated as well as dilute; and that in the case of electrolytes the solutes are electrolytically dissociated, the so-called degree of electrolytic dissociation being calculable according to the well-known formula of Arrhenius even in concentrated solutions, at least approximately. On the basis of these assumptions it is computed what the molecular lowering of the freezing-point ought to be; and from this value and that actually found in practise, it is calculated how much water is combined with the solute. In other words, the method simply consists of assuming just so much of solvent as combined with the dissolved substance in any given case as is necessary to make the simple gas laws hold even for concentrated solutions. That the gas laws do not hold for concentrated solutions, even approximately, is a well-recognized fact; and consequently the numerous computations of the approximate composition of the supposed hydrates in the solutions studied and the curves representing the variations of the composition of these hydrates with change of concentration need not be further considered here, for they are quite valueless. The republication of the results of the calculations of the composition of these supposed hydrates in this monograph is all the more inexcusable because Van Laar[1] had already called attention to the gross error of Jones and Getman when a part of the work appeared in the *Zeitschrift für physikalische Chemie*, 49, 385, 1904.

While then the monograph has failed in what must be regarded as its main objective, namely, the computation of the approximate composition of hydrates in solution, the large bulk of experimental evidence presented, though also in part not new, undoubtedly goes to show that solutions are not merely mechanical mixtures, but that combination of a specific nature does take place between solvent and solute. The experimental data recorded will no doubt prove useful in the future.

Part II. of the paper, pages 161 to 259, presents the results of H. S. Uhler of the study of the absorption spectra of aqueous solutions of cobalt chloride, copper chloride and copper bromide and of these solutions mixed in different proportions with calcium chloride, calcium bromide or aluminum bromide. The absorption spectra of cobalt chloride, copper

[1] *Chemisch Weekblad*, 2, 6–8, 1905. Abstract in *Chem. Centralblatt*, 76, 491, 1905. Also reprinted in 'Vorträge über thermodynamisches Potential,' pp. 6–8; published by Vieweg u. Sohn, Braunschweig, 1906.

chloride and copper bromide in methyl and ethyl alcohol and in acetone are also studied. Photographic records showing the absorption bands in the different solutions are presented. These photographs show admirably how the absorption bands gradually change as the various dehydrating agents mentioned are added to the solutions. In the discussion of the results the difficulties met in interpreting spectroscopic observations of this kind are clearly set forth. In fact the second part of the monograph is more carefully and judiciously written than the first part, the latter containing practically no reference to the experimental work of others, whereas in the second part the work and opinions of other investigators receive due consideration. Attempts to deduce the approximate quantitative composition of the hydrates in solution from the study of the absorption spectra are, of course, not made, for such observations do not lend themselves for that purpose. It is simply claimed that the results bear out Jones's ideas of hydrates in solution in a satisfactory manner.

Louis Kahlenberg
University of Wisconsin,
May 10, 1907

Electrons or the Nature and Properties of Negative Electricity. By Sir Oliver Lodge. London, George Bell and Sons. 1906. Pp. xvi + 230.

Up to the time of the publication of Maxwell's 'Treatise on Electricity and Magnetism' in 1873, in which the ideas of Faraday were subjected to mathematical analysis, and greatly extended, the preponderating rôle which the luminiferous ether plays in electrodynamic phenomena had been almost entirely overlooked by theoretical physicists. Attention had been concentrated upon electrical charges and currents, and the influence of the medium which transmits electric and magnetic forces was quite neglected. The steady progress of Maxwell's theory, its evident superiority to its older rivals, and its final triumphant verification by Hertz, naturally caused the pendulum to swing to the other extreme; so that in the early nineties students of physics learned much of tubes of force and ethereal displacement, but had little to do with electric charge, except as a rather old-fashioned idea still useful for certain purposes, but really only a short name for a certain mathematical function of the ethereal displacement.

Time, however, has wrought its revenges. When Maxwell's theory was applied to the finer details of the electrical and optical behavior of matter, especially of moving matter, it was found necessary to reintroduce the definite conception of electric charge in very concrete form; its atomic structure was recognized, and the name 'electron' was given to the atom of electric charge. These theoretical conclusions of Lorentz and Larmor have been strikingly confirmed by a great number of experimental results in widely different fields of investigation. The discovery of the Zeeman effect, the investigation of the nature of cathode rays and of the ionization of gases by J. J. Thomson and his followers, the phenomena of radioactivity and many other facts new and old find their natural explanation in terms of the electron theory. Indeed we have some ground for anticipating a much wider extension of the theory; it is not impossible that we may come to believe that all matter is made up of electrons, which will thus form the raw material out of which the material universe is constructed.

In the book under review, Sir Oliver Lodge has given a simple and lucid account of this theory, of its triumphs and difficulties, and the possibilities of its future development. He tells us that the book "is intended for the student of general physics, and in places for specialists, but most of it may be taken as an exposition of a subject of inevitable interest to all educated men." It is in fact not quite a 'popular' exposition of science in the ordinary sense, and one will look in vain for the exaggerations and over-statements which are too often characteristic of such works. It appeals rather to the discriminating *amateur* of scientific knowledge who has some knowledge of electricity and who will not be hopelessly frightened or repelled by an occasional simple algebraic or trigonometrical expression.

Readers of this class will doubtless find this book of great interest, and the general view and perspective of the subject will also be of value to the professional physicist. It is written with the spirit and enthusiasm which we have learned to expect from Sir Oliver Lodge since the publication of his 'Modern Views of Electricity'—nearly twenty years ago—that remarkable little book which, by a masterly use of mechanical analogies and models, gave an exposition of Maxwell's theory that was understood and enjoyed by many non-mathematical readers and was at the same time capable of exciting the admiration of Helmholtz. It can not be said that the present work is the equal of the earlier book; but taken together they afford a view of the progress of electrical theory during the past thirty years which can hardly be got elsewhere in the same compass.

H. A. BUMSTEAD
YALE UNIVERSITY

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 191st meeting of the society, held on Wednesday, April 10, Mr. F. E. Wright exhibited four new attachments for the petrographic microscope and gave a brief description of each: (*a*) Double screw micrometer ocular by means of which the optic axial angle of any section under the microscope can be measured in convergent polarized light, if one optic axis, at least, appears within the field of vision. (*b*) A special cross-section ocular, which consists of a Ramsden-Czapski ocular with a fine coordinate scale in the focal plane and which serves the same purpose as the double-screw micrometer ocular, although slightly less accurate. (*c*) An improved Fedorow-Fuess universal stage on which new hinged graduated circular scales have been added and found to increase the general applicability of the stage considerably. (*d*) A new condenser-lens system combining the advantages of the ten Siethoff system with the quantitative movements of the universal stage.

Regular Program

Mr. Bailey Willis discussed the geological problem of the Alps especially from a structural standpoint and compared the conclusions reached by him with those held by the majority of European students of the Alps.

At the 192d meeting of the society, on April 24, Mr. Bailey Willis presented and briefly explained a diagram on the possible development of recumbent folds as a consequence of thrust faults of great magnitude. This paper will be published in SCIENCE.

Mr. F. L. Hess exhibited informally specimens of gypsum from Lost Hills, fifteen miles south of Tulare Lake, California.

Regular Program

A Peculiar Form of Metamorphism in Siliceous Sandstone: Mr. GEO. P. MERRILL.

Mr. Merrill described a peculiar and apparently very local form of metamorphism of the siliceous sandstone which underlies the Aubrey limestone in the vicinity of Canon Diablo, Arizona. The materials shown and discussed were from the so-called Coon Butte Crater, and were of unusual interest, not merely on account of the character of the phenomena, but as bearing upon the question of the origin of the crater itself.

It was shown that the sandstone, composed of very pure quartz sand, passed by gradations into an almost wholly crystalline rock composed of remolded quartz granules with a well-developed rhombohedral cleavage, and thence into glassy and pumiceous forms closely resembling a bleached liparite pumice. The metamorphism was accompanied by no apparent chemical changes that could be considered constant or essential. Mr. Merrill discussed the bearing of this metamorphism upon the origin of the crater, but refrained from committing himself upon the subject.

Normal Faulting in the Bullfrog District: W. H. EMMONS. This paper will be published in SCIENCE.

Some Problems Concerning the Formation of Coal: DAVID WHITE.

Under this title Mr. White presented an outline of the more important questions relating to the deposition of vegetable matter and its transformation into coal. He observed that the 'transportation' theory appeared to be fully vindicated in a number

of instances, though in the vast majority of cases the plant material seemed to have undergone little, if any, appreciable drifting. The great extent and regularity in thickness, including partings and benches, of the Pittsburg bed in the Appalachian trough appeared not to find a completely satisfactory explanation in either the transportation or the peat-bog theories. Referring to the fact that the process of coal formation is marked chiefly by the progressive deoxygenation of the vegetable matter, especial attention was directed to the most important rôle played by anerobic bacteria in the decomposition of the plant tissues and their incipient coalification. Though it is not yet determined how far bacterial action may have gone in changing vegetable matter into bituminous coal, etc., the function of these deoxygenating organisms in accomplishing the primary stages of coal formation, including at least the breaking down of the vegetable hydrocarbons and the development of the fundamental jelly, is now rapidly gaining acceptance on the part both of geologists and of chemists. Concerning the successive development of lignites, bituminous coals and anthracites there still remain radical differences of opinion, it being maintained by many, including several paleobotanists, that the higher grades of coals have never passed through a peaty, lignitic or other lower stage. The solution of this problem, whose principal point is the origin of the bituminous coals, is awaited with the greatest interest. The speaker urged that the cause of anthracitization in the Eastern Appalachian regions rested primarily not in local folding, but in the deeper-seated metamorphism due to the great post-Carboniferous Atlantic thrust. This is shown by the progressive devolatilization of the coals in passing eastward across the Appalachian basins. The folding was merely incidental and relieving.

Another group of problems involves the determination of the very intimate and important relations existing between the kinds of original contributary organic matter and the kinds and qualities of the resultant fuels. It is known that certain groups of coals owe their principal distinctive features to the nature of their original constituents. In this connection the speaker suggested that the coking property in some of the Appalachian coals was probably due to a combination of 'sapropelic' (fatty) or strictly bituminous organic matter, with the ordinary 'humic' (jetty, brilliant) or so-called 'bituminous' coal-forming material, which is largely composed of the remains of the higher types of plants.

Emphasis was put on the urgent need for new and more complete experiments in synthetic coal-making, concerning which the testimony of previous experimenters is highly conflicting. Such experiments carried out with new and more adequate methods and equipment, comparable to those employed in the Geophysical Laboratory of the Carnegie Institution, would not only furnish most valuable data relating to coal transformation, but they would also probably furnish a conclusive answer to the question of the development of bituminous coals or anthracites through peat, lignite, or subbituminous coal stages.

The Jamaica Earthquake: Mr. J. W. Spencer.

Jamaica is separated from the volcanic and earthquake zone of the Windward Islands by the broad deep basin of the Caribbean Sea, nearly 1,000 miles across, and from that of Central America by about 600 miles. Jamaica is on a plateau connecting this latter region with Haiti; but much the greater part of the intervening distance between the Central American volcanic and earthquake zone and the island is occupied by low plains, or these only slightly submerged beneath the sea, and crossed by one relatively narrow channel reaching to a depth of nearly 3,000 feet. The trend of this Jamaican ridge being at right angles to the lines of the earthquake actions of the two ends of the Caribbean Sea, it would seem that the seismic effects could not have any relationship with others of the region so far away. Moreover, Jamaica is not volcanic, with only the remnants of one Pliocene volcano upon the northern coast. On its southern side, which is mostly a plateau from one to two thousand feet high, capped by white Oligocene limestones much denuded, a coastal

plain extends some ten miles seaward under less than 100 feet of water. Above the sea the plain is only five or six miles wide to the base of the mountains. Kingston is situated on the side of a long narrow bay separated from the sea by a beach ridge called the Palisades, on the point of which is Port Royal. A short distance east of Kingston the mountains come to the sea, which suddenly deepens to 500 feet within a half mile of the shore. This is the head of an embayment in the mass of submerged land, and plunges rapidly to a depth of 4,000 feet. Beneath the limestones mentioned are Pteropod oozes, which are exceedingly plastic when wet. The earthquake, while felt over the island, was only intense about Kingston, and still more so to the east at the head of the submarine embayment mentioned. As this is the second great earthquake which has occurred here within recent times, Mr. Spencer was inclined to regard this local feature of the deep embayment as its direct cause; and suggested that it might possibly be due to a gigantic submarine landslide originating perhaps at a depth of 4,000 feet or more. The land appears to have shifted and part of the beach of Port Royal has sunken beneath the sea, which is a repetition of the features of the former earthquake. While part of the possible submarine shifting is due to this material, as at Port Royal, a greater cause might be found in the movement of the consolidated beds over the Pteropod ooze similar to gigantic creeping over similar beds in Barbados.

FRED E. WRIGHT,
Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 635th meeting was held on May 11, 1907.

Mr. Becker read a paper on current theories of slaty cleavage which will soon appear in the *American Journal of Science*. The speaker first mentioned very briefly the views of various writers concerning the origin of cleavage, but dwelt at some length upon the theories of Sharpe, Van Hise and Leith. Sharpe's theory was that cleavage is due to pressure normal to the cleavage plane. Sedgwick and others held cleavage mainly a phenomenon due to crystallization or recrystallization of minerals in an appropriate orientation. Messrs. Van Hise and Leith have sought to combine and amplify these theories. They hold that minerals, especially mica, tend to crystallize perpendicularly to the greatest stress and also perpendicularly to the least axis of the strain ellipsoid.

Mr. Becker pointed out that the chances of a pure strain, such as called for by Sharpe's theory, are extremely small, not more than one in 10,000 and probably much less. The surfaces perpendicular to the greatest internal stress in a homogeneous mass subjected to progressive uniformly distributed normal external pressure are the equipotentials and are well known to be hyperboloids of revolution. They are thus surfaces of double curvature corresponding to no known phenomena in slates. In the case of rotational strains the equipotentials would be still more complex and become intersecting systems of surfaces of double curvature, and thus still less available to explain cleavage.

Mr. Becker took up one by one the lines of evidence presented by Mr. Leith to establish the position of the strain ellipsoid and the hypothesis that the least axis is normal to the cleavage. The elongation of pebbles is not applicable to this purpose, for the final form and attitude of a pebble result from the superposition of the strain ellipsoid and the rotation of the strain on the original ellipticities of the pebble. Its elongation does not even tend to coincide with that of the strain ellipsoid excepting in highly exceptional limiting cases. Numerical examples were given showing that pebbles of ordinary forms may be elongated in directions 20° or 30° from the major axis of the strain ellipsoid. Fossils as hitherto treated afford no better guide.

Mr. Becker showed that the slicing of pebbles could be satisfactorily explained on the theory that cleavage as well as jointing occurs on planes of maximum slide. He rejected Mr. Leith's inferences from the evidence and concluded:

It appears to me that Mr. Leith is in duty bound to make public exact reasons for his asser-

tions, to give precise methods for determining the position of the strain ellipsoid or the equipotentials in a slate, to show why there is no cleavage on planes of maximum slide, and to explain thermodynamically how it happens that the planes on which the entire energy of deformation is expended are not those on which feldspar is converted into mica. We are past the stage in which mere opinions or general impressions should be allowed decisive weight.

At the conclusion of Mr. Becker's paper its discussion was taken up by Mr. Bailey Willis with special reference to other theories of rock cleavage. Mr. Willis called attention to the very broad observational basis of the explanations of rock cleavage given by Messrs. Van Hise and Leith and pointed out that Mr. Becker approached the problem as one of pure mathematics and solved all the complex phenomena by a single theoretical application of principles. Granting the correctness of the principles and their appropriate application to a purely mechanical distortion, one may very reasonably question their adequacy to explain the facts emphasized by Leith, namely, the rearrangement and recrystallization of minerals with parallel orientation of crystalline cleavage and major axes of particles.

Leith recognizes a variety of cleavage (fracture-cleavage) developed in the planes of maximum slide, as Becker calls them, but limits that development to the zone of fracture. Willis took exception to this limitation and expressed the view that in regions of great tangential movement displacement on planes of maximum slide (*i. e.*, on planes oblique to the direction of tangential pressure) may occur in a deep-seated zone, where fracture is impossible and flow cleavage develops by recrystallization and orientation in those oblique planes. The Appalachian region of North Carolina appears to present such displacement with appropriate cleavage.

On the other hand, there are regions where the movements of large masses are essentially vertical, as is shown by warping of the surface. Such an area is that of the Canadian Highlands. In so far as the vertical swelling may be attributable to tangential stress it indicates vertical elongation of the mass, which may be and probably is accompanied by recrystallization and orientation of mineral particles, producing flow cleavage in the normal planes.

Thus it seems probable that cleavage involves molecular rearrangement, of which Becker does not take sufficient account, and that flow cleavage may develop in oblique planes, which Leith does not consider, as well as in the normal planes, which he does recognize.

R. L. Faris,
Secretary

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The annual meeting of the Washington Anthropological Society was held May 28, 1907, with Mr. J. D. McGuire in the chair. The program consisted of the annual report of the treasurer; preliminary communications; notices of deceased members; and annual election of officers.

The treasurer's report showed that during the fiscal year ending December 31, 1906, the total receipts amounted to $587.78, the total expenditures to $398.22, leaving a balance of $189.56.

Mr. Hewitt presented an extract of the monthly field report of Dr. J. R. Swanton, bearing on the scattered remnants of the Indian tribes in Louisiana.

The obituary notices were delivered as follows: (1) Dr. Cyrus Thomas on Dr. Ernst Foersterman, of Germany, honorary member of the society, born 1818, died 1906. Special reference was made to his contributions to the knowledge of the Maya hieroglyphics. (2) Professor W. H. Holmes on Sr. Alfredo Chavero, born in Mexico, 1822, died 1906. He was equally eminent as litterateur, statesman and archeologist. (3) Mr. J. Mooney on Dr. Albert S. Gatschet, born in Switzerland in 1832, died in Washington, 1907. Dr. Gatschet was for many years on the staff of the Bureau of American Ethnology, and devoted himself principally to the linguistics of the American aborigines, in which field he was a successful pioneer. (4) Dr. A. Hrdlička presented a notice on Professor Emil Schmidt, born in 1837, died in 1906, in Germany. Professor Schmidt's spe-

cial field was physical anthropology, in which he did great service in Germany. He contributed important studies to the anthropology of Egypt, South India and Ceylon, and particularly to that of the prehistoric times in North America, which country he twice visited.

The election of officers for 1907–8 resulted as follows:

President—Aleš Hrdlička.

Vice-presidents—Section of Somatology, D. S. Lamb; Psychology, J. W. Fewkes; Esthetology, W. H. Holmes; Technology, Walter Hough; Sociology, James Mooney; Philology, J. N. B. Hewitt; Sophiology, Alice C. Fletcher.

General Secretary—Walter Hough.

Secretary to Board of Managers—J. R. Swanton.

Treasurer—Geo. C. Maynard.

Curator—Marianna P. Seaman.

Councilors—J. W. Fewkes, J. B. Nichols, James Mooney, J. N. B. Hewitt, J. R. Swanton, W. E. Safford, F. W. Hodge, J. M. Casanowicz, Sarah S. James, P. Beckwith and F. O. Stetson.

Committee on Communications—W. H. Holmes, Alice C. Fletcher, James Mooney.

J. M. CASANOWICZ,
Acting Secretary

THE CHEMICAL SOCIETY OF WASHINGTON

THE 175th regular meeting of the Chemical Society of Washington, and joint meeting with the American Society of Biological Chemists was held at the Cosmos Club, May 9, 1907, Dr. Peter Fireman, of the Chemical Society, and Dr. W. J. Gies, of the Biological Society, presiding.

The following program was carried out:

Chemical and Bacteriological Standards now in Use in Water Analysis: JOSEPH H. KASTLE.

Ammonia in Milk and its Development during Proteolysis under the Influence of Strong Antiseptic: H. C. SHERMAN, W. N. BERG, L. J. COHEN, and W. G. WHITMAN.

Studies on Apple Juice: H. C. GORE.

Sugar Metabolism: HUGH MCGUIGAN. (Read by title.)

The Presence of Secondary Decomposition Products of Proteids in Soils: OSWALD SCHREINER and EDMUND SHOREY.

On Lysylglycin: P. A. LEVENE and W. A. BEATTY.

Negative Evidence of the Development of Ferments of Dog's Saliva in Adaptation to Diet: WALTER E. GARRY. (Read by title, but results of investigation were discussed by Dr. L. B. Mendel and Dr. W. J. Gies.)

Some Azolitmin Compounds of Mucoids, Nucleoproteins, and other Proteins, with Exhibition of Products: JACOB ROSENBLOOM and W. J. GIES.

On the Quantitative Determination of Mucoid in Urine, Blood and Tissue Extracts: C. E. MAY and W. J. GIES.

J. A. LECLERC,
Secretary

THE TORREY BOTANICAL CLUB

THE meeting for May 14, 1907, was called to order at the American Museum of Natural History with President Rusby in the chair. One hundred and four persons were present.

The scientific program consisted of a symposium of four papers on the subject of 'Trees.' Each paper was illustrated by lantern views. The symposium was opened by Professor L. M. Underwood, who spoke on 'Some Historic American Trees.' Mr. William Solotaroff discussed 'The Planting and Care of Shade Trees,' giving an interesting account of the preparation for planting in the nursery, methods of transplanting along highways and streets, the dangers that threaten shade trees, and briefly of the means of protecting against these dangers.

Dr. E. B. Southwick spoke on 'Trees in Winter,' showing views taken in Central Park, and elsewhere in and about Greater New York. The last number was by Dr. N. L. Britton, who showed a selection of colored lantern slides from the Van Brunt collection, illustrating the flowers and fruits of common trees.

At the conclusion of the regular program, Mr. Edward R. Taylor, of Pen Yan, N. Y., exhibited some beautiful, and botanically interesting, samples of 'vegetable silk,' and fabrics woven from it, together with the raw material of which it is made. The process of its manufacture from cotton-seed-cellulose

was briefly described, and samples of 'artificial horse-hair,' made by treating ordinary cotton thread with the dissolved cotton-seed-cellulose, were also exhibited and the process of its fabrication briefly described.

C. Stuart Gager,
Secretary

IOWA ANTHROPOLOGICAL ASSOCIATION

The fourth yearly meeting of the Iowa Anthropological Association was held at the Davenport Academy of Sciences, Davenport, Iowa, on Friday and Saturday, May 17 and 18, the sessions being well attended. On Friday evening Professor Frederick Starr, of the University of Chicago, delivered an address on 'The Field of Folk-lore in Mexico,' illustrated with stereopticon views. On account of his numerous trips to Mexico and his intimate acquaintance with the people of that country, Professor Starr's address was of unusual interest.

On Saturday morning, after some introductory remarks by the president, Professor B. F. Shambaugh, of the University of Iowa, and the report of the secretary, J. H. Paarmann, curator of the Davenport Academy of Sciences, there were a number of papers by members of the Davenport Academy of Sciences dealing with different aspects of the explorations recently made near Albany, Whiteside County, Illinois. These were as follows:

Edward K. Putnam: 'Bibliography of the Albany Mounds.'

Professor Samuel Calvin, University of Iowa: 'The Geology of the Region in the Vicinity of Albany.'

W. H. Kimball: 'Report of the Survey of the Albany Mound District.'

J. H. Paarmann: 'Report of the Opening of Two Mounds Near Albany.'

Dr. A. W. Elmer: 'Iron found in the Albany Mounds.'

J. E. Calkins: 'Some Puzzles at Albany.'

After luncheon at the Davenport Commercial Club, various papers on current anthropological topics were presented as follows:

Richard Herrmann, Dubuque, Iowa: 'Mound Builders of the Mississippi Valley.'

Professor Bohumil Shimek, University of Iowa: "The Loess and the 'Nebraska Man.'"

Professor C. C. Nutting, University of Iowa: 'Urn Burial on the Island of Ometepe, Nicaragua.'

Rabbi W. H. Fineschriber, Davenport, Iowa: 'Some Facts of Jewish Anthropology.'

Professor Frederick Starr, University of Chicago: 'The Davenport Academy's Collection of Objects from the Upper Kasai, Congo Free State.'

The following officers were elected:

President—Edward K. Putnam.
Vice-President—Bohumil Shimek.
Secretary—J. H. Paarmann.
Treasurer—A. G. Smith.
Executive Committee—F. J. Becker, I. A. Loos, G. T. Flom, C. C. Nutting and A. W. Elmer.

On Saturday evening a meeting was held to organize an Iowa branch of the American Folk-lore Society, the program being as follows:

Edward K. Putnam, Davenport Academy of Sciences: 'Introductory Remarks on Folk-lore.'

Professor Charles Bundy Wilson, University of Iowa: 'German-American Folk-medicine.'

Professor G. T. Flom, University of Iowa: 'The Myths of Creation and Doom in Norse Mythology.'

Professor Jules Mauritzon, Augustana College, Rock Island, Ill.: 'Traces of Old North Heathenism in Swedish Christmas Customs of To-day.'

Professor Charles Bundy Wilson, of the University of Iowa, was elected president and Edward K. Putnam, of Davenport, secretary.

J. H. Paarmann,
Secretary

DISCUSSION AND CORRESPONDENCE

THE FIRST SPECIES RULE: AN OBJECTION

To the Editor of Science: The rules that have been drawn up by a committee of American zoologists, with a view of determining the genotype of every genus in a manner that can admit of no uncertainty, may perhaps not yet have been published, but, to judge from the manuscript copy which I have been permitted to see, they are admirably adapted to secure their object. The question remains whether the object is a good one; and it is the purpose of this letter to point out a set of cases in which the selection as genotype of the

first species mentioned would be likely to introduce confusion.

When genera are based on recent species it may be assumed that, as a rule, no one species is more obscure than another, so that, *ceteris paribus,* there is no objection to taking as genotype the first mentioned. Indeed the first mentioned is in most cases likely to be the best known, although every one is aware that it is not so in all cases. But when genera are based mainly or entirely on fossils there is a great difference between the values of the different species. The common-sense thing to do in such a case is to select the most completely preserved and best-known species as genotype.

If now one considers the general action of previous revisers in dealing with paleontological material, one notes a general tendency either to select as genotypes, or at all events to regard as representative, those species which are the least obscure. In other words, the historical development of the science has resulted in the common-sense method of interpreting genera by their best known species.

To leave the selection to an arbitrary rule that is as likely as not to fix on an obscure fragment would in itself be contrary to common sense; but the first species method now proposed not merely ignores these important factors of clearness and familiarity, but actually tends in the case of fossils towards the greatest obscurity. For this reason, many new species established by paleontologists have been introduced in monographs or papers dealing with series of fossils from various horizons; and it has generally been the custom of paleontologists, in discussing the species under review, to follow a stratigraphical order, beginning with the oldest rock. Consequently, when a paleontologist founds a new genus, the first species that he mentions is generally the oldest, and for this very reason it is generally also the most obscure. In many cases then the first species rule would lead to the inevitable selection of the most obscure species as the type of a genus. A rule of which this can be said may work with mathematical exactness and automatic precision, but its final result must be to introduce, or rather to force, into zoological nomenclature fresh elements of uncertainty and change.

F. A. BATHER

LONDON, S. W., ENGLAND,
April 29, 1907

THE GREAT INFERIOR TUSKED MASTODON OF THE LOUP FORK MIOCENE

IN 1882 I discovered a jaw of this mastodon on the Sappy, in Decatur County, while in the employ of the Museum of Comparative Zoology at Cambridge. A single jaw was present measuring four feet to the end of the tusk. Last year while on an expedition for the Royal Museum of Munich in the same beds on the Prairie Dog, I collected a very perfect set, without the tusks; length of the preserved jaws two and a half feet, height at condyles fourteen inches, height of grinding surface of the single last molar nine and a half inches. Last season my son was so fortunate as to discover in Scott County, near the Gove County line, a very complete and well-preserved set of lower jaws of a huge specimen so different in several respects from the other two mentioned, a separate form may be represented. The peculiarity lies in the low condyle that is only thirteen and a half inches high, and in the great depression of the rostrum, thirteen inches lower than the teeth at its distal end. The length of the jaws are four feet and one inch long. The distance between the condyle and distal end of rostrum or beak, four feet three and a half inches. But one well-preserved molar, the last, in each jaw their greatest height is ten inches; height of crown two and a half inches, length nine and a half inches, width three inches, distance between the molars four inches. This is the largest specimen in my experience ever taken from the Loup Fork Miocene beds of Kansas, and point to an animal of large proportions.

In this connection I would like to put on record the description of the largest tusk of *Elephas columbi,* or the great Columbian mammoth, of which such a fine example is now mounted in the American Museum, New York City. I discovered this tusk with a lot of teeth; several of them are now preserved in the State University Museum of Kansas and

others in the American Museum in Lane Co., Kansas.

It measured fourteen feet in length and was eight inches in diameter at its proximal end where it was broken from the upper jaw. Dr. Matthews assures me that it is the largest specimen so far recorded, I regret to say that it was not saved owing to its friable nature.

CHARLES H. STERNBERG

CONCERNING STENO

TO THE EDITOR OF SCIENCE: It happens to all of us to fancy that what is new to us must be new to the world; and if we fail to look in the right places we do not become disenchanted.

The recent reference in SCIENCE (May 10) to Steno's noted work on crystallography and a newly-discovered English translation of it, led me to wonder if all the great bibliographers had overlooked the latter. The four authorities that came to hand first were Brunet, the British Museum Catalogue, Watts's 'Bibliotheca Britannica' and Poggendorff's 'Biog.-lit.-Worterbuch'; all of these include H. O.'s translation of Steno, except Brunet, who has few scientific titles and does not include this in any language. The translation is also cited in the 'Catalogue' appended to Young's 'Natural Philosophy,' about 1805.

The guess and conclusion that H. O. was Henry Oldenburg is confirmed by the article about him in the 'Dictionary of National Biography.'

This incident will strengthen the views of those who think that a prerequisite to any advanced degree should be a short course in bibliography; for, whatever Pope meant by his lines, they are increasingly true to-day:

> * * * Index-learning turns no student pale,
> Yet holds the eel of science by the tail.

C. K. W.

WASHINGTON, D. C.,
June 4, 1907

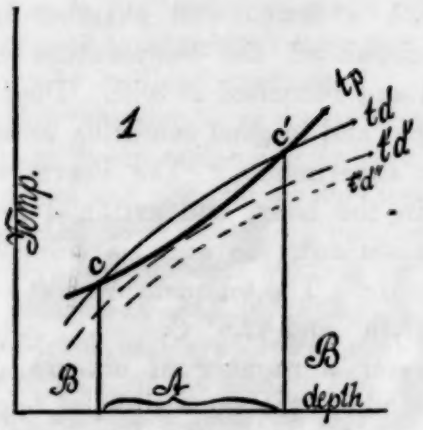
SPECIAL ARTICLES

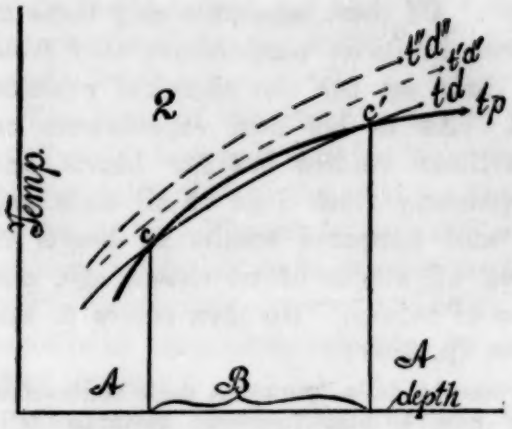
ON SUN SPOTS

APROPOS of certain recent discussions on solar activity to which I listened with pleasure in Philadelphia, I have wondered whether a possible analogy between geyser-like action and periodic solar disturbance has been suggested. For instance, let the line *td* in the diagram represent the distribution of temperature and depth below the solar surface, or, from some points of view, the distribution of temperature relative to pressure. Let the line *tp* represent the condition of transition, referred to temperature and depth, from an atomic form *A* to an atomic form *B*. Below the *tp* line the element *B* is stable, above it *A* is stable. At depths corresponding to *c* or *c'*, therefore, neither form is persistently stable, but as the spherical shells are thin there need be no marked consequences. To make the engine work, two points of intersection, *c*, should occur.

I shall assume that the transition of *A* into *B* takes place along a doubly inflected intrinsic isotherm for the system *AB*, after the manner explained by James Thomson and Van der Waals. It therefore requires a certain amount of 'supersaturation,' or an excess of heating, to affect the transfer from *A* to *B*, in the absence of special external interferences. I shall also assume that the transfer *A* to *B* is accompanied by an evolution of heat, *B* to *A* by an absorption of heat, and that the *A* matter is eliminated from the whole active region by gravitational convection. Finally different atomic forms are arranged between concentric spherical shells, according to their density.

Suppose, therefore, as a first alternative, that after a sun-spot period, the *td* line has been depressed by the sudden cooling of all active strata to the position *t'd'* in Fig. 1. The points *c* have been displaced towards each other and have quite vanished from the curve. *B* matter only is present. In the lapse of time, however, the line *t'd'* again rises to reach *td*, due to heat arriving from below, within the depths bracketed in the now unstable state *A*. It is agreed that the *td* position will have to be very closely approached, or a considerable 'supersaturation' will be required, before another eruption occurs, which drops the *td* line to *t'd'* in turn. Whereas the depression of this line is relatively sudden, its gradual rise together with the prop-





erties of the *AB* system determines the frequency of the sun-spot period: the element *A* escapes (let us say) in gaseous form. As the curves are drawn there is not sufficient 'supersaturation' to transmute *A* to *B*. This would occur at *t''d''* for instance.

The relation of the curves *td* and *tp* will vary with the solar latitude, for *td* is a mere graph of temperature and depth while *tp* is inherently a graph of temperature and pressure. On passing from pole to equator *tp* moves bodily from left to right in diagram. At the poles the region *A* may thus be permanently absent, while at the equator *t'd'* may never fall below *tp*. Hence, an intermediate sun-spot zone may be inferred.

Finally it is clear that the cycle of changes may be reversed as in Fig. 2. Let the transition of *A* into *B* be a source of heat, and let the ensuing eleven years of the sun-spot period be an interval of cooling. Immediately after eruption, the temperature depth line will have some high position, *t'd'*, and *A* matter only is in occurrence. As the sun cools superficially, *t'd'* tends toward *td*, and between the depths *c* and *c'*, *B* matter is potentially present. When, after sufficient 'supersaturation,' the transition *A* to *B* ultimately does occur, *tp* is again raised to *t'p'*; and so on in turn. The engine works at the expense of atomic energy, supposing that *B* matter[1] is continually eliminated from the active region by gravitation, as the *t''d''* condition is not reached.

CARL BARUS

[1] If corpuscles leave *A* to transfer it into *B*, an absence of these may prohibit the reversed transfer *BA*.

DOES THE MAMMALIAN HEART OBEY THE LAW FOR CHEMICAL REACTION VELOCITIES AS INFLUENCED BY TEMPERATURE?

IN a recent paper[1] it was shown that the temperature coefficient for the velocity of the heart-beat in mammals is the same as that for a purely chemical reaction. From the results of previous workers who experimented upon the influence of temperature upon the mammalian heart this fact was shown in a clear and decisive manner. At that time the writer had not yet seen Herlitzka's paper.[2] This author takes data out of only three of the fifteen to eighteen tables in Langendorff's paper, and determines a few constants. In one case, table XIV., in a range of temperature from 23° to 39° C., he exhibits only five constants. Between 29° and 35.2° there are no constants shown, but for these degrees he finds the constants 3.45 and 10.8, and then complains that these constants do not represent the curve of the formula for a chemical reaction velocity for temperature, but rather a straight line. In tables VII. and VIII. he says that the values observed correspond well enough with the values of *K* calculated from the formula, but that one, for 35° (3.74), is too high!

Herlitzka has looked at a few individual cases of Langendorff's results. On the other hand, the present writer put all of Langendorff's results (from fifteen cat hearts) together into one table; put the figures in round numbers and determined the constants from

[1] Snyder, Charles D., *Amer. Jour. of Physiology*, December 1, 1906.

[2] Herlitzka, 'Richerche sull' azione della temperatura sul cuore isolato di Mammifero,' *Zeitschrift f. Allgemeine Physiologie*, V., 264, 1905.

10° to 46°. Of these constants only those at the extreme limits of temperature vary from the 2–3 limit set for the chemical reaction constant. As to his own experiments on dogs, Herlitzka studied but few hearts, and these apparently from dogs of all sizes and weights, and compares results of hearts in apparently all stages of nutrition, age, size and state of injury. He then comes to this conclusion (p. 286):

2°. L'aumento della frequenza delle contrazioni cardiache non è una funzione costante della temperatura, ma varia da un cuore all' altro ed anche nello stesso cuore in varie fasi dell'esperimento. A volte si tratto di una funzione lineare; raramente e mai completamente la frequenza seque la legge a cui soggiaciano le comuni reazioni chimiche, gli enzimi, l'accrescimento ecc.

As to what value should be placed upon this author's work and his conclusions, this must be left to the decision of the intelligent reader.

In the paper already referred to the writer has shown from Martin's results that the dog heart obeys the law for chemical reactions as closely as if one were dealing with pure chemicals. Not only when studied statistically, then, but also when the individual heart of the mammal is studied, is this found to be the case. The same relation was shown to hold for the rabbit heart and, in an unexpected way, also for the human heart.

While the thesis seems to be proved beyond doubt the writer will be pardoned if he adds still other evidence.

Baxt[1] studied the effect of temperature upon the dog heart primarily to find out the influence of temperature upon the action of the vagus and accelerens nerves. But in recording his results he always put down the temperature and rate of the heart before stimulation. So it happens we have in his paper considerable data for further study of the temperature coefficient of the 'normal' heart of the dog. Under the conditions of his experiment the temperature of the animals had a tendency to fall off. By surrounding the dogs with a double-wall chamber in which water circulated the temperature could be lowered and increased at will. Dogs of middle weight and in good condition were selected for the experiments. The hearts were left intact in the body, and artificial respiration was maintained, the animals being poisoned with curare. The temperature was varied between 27.15° and 42.8° C.

Wherever a number of observations were made, at about the same time, of temperature and rates of very nearly the same value, the writer determined averages for them. These averages were compared with rates at lower or higher temperatures and their coefficients interpolated by the formula, $10R_1/R_2(t_1 - t_2)$, where R_1 and R_2 are rates at the corresponding higher and lower temperatures, t_1 and t_2. These coefficients are: (1) From pages 339–340, for 'A'—2.18, 2.3, 2.0; for 'B'—2.3, 2.7. (2) From page 341, for 'A'—2.2, 2.6; for 'B'—2.5, 2.0, 4.3, 3.1, 3.6, 4.0. (3) From page 342, for 'A'—2.2, 2.0, 3.1, 2.5, 3.1, 2.6, 2.4, 3.9; for 'B'—1.7, 2.6, 2.7, 2.2, 2.2, 2.8, 2.6, 2.5. (4) From page 356—1.2, 1.8, 2.5, 2.5, 2.0 1.7, 2.4, 2.6.

Of the individual coefficients shown above the lowest is 1.2, the highest 4.3; 71 per cent. of them range between 2 and 3. The mean average is 2.43. Verily, the mammalian heart does follow the law for a chemical reaction velocity as influenced by temperature.

Charles D. Snyder

Berlin,

[1] Baxt, *Berichte d. K. Sächsischen Gesellschaft der Wissenschaft*, Leipzig, Math. physik. classe, 1875.

THE FLANKING DETRITAL SLOPES OF THE MOUNTAINS OF THE SOUTHWEST

General Aspect and Grade of Detrital Slopes.—The attention of travelers in the southwestern portion of the United States is arrested by the long and regular slopes of gentle grade flanking the rocky ridges of the mountains, and stretching in unbroken lines, often for ten or twenty miles, across the line of vision. Such slopes are most distinctly developed in the Great Basin of Nevada and the semi-desert Piedmont region of Arizona. They give a striking and unique character to the scenery, producing upon the beholder

the impression that the wide ocean must have been the agent causing such sweeping outlines and regularly inclined surfaces.

The great table lands, or plateaus, so-called, of the Great Basin region are, in fact, a series of long slopes and not tabular surfaces. This is most notable in the southern portions of the basin, where the general surface is inclined from an altitude of about 4,000 feet downward to the sea-level, and even below that level, as at Death Valley, Nevada. The bordering mountains, and each detached mountain ridge or peak in that region, known as 'Lost Mountains,' are flanked by detrital accumulations from the high rocky ridges.

A fine example of a flanking slope is found on the north side of San Bernardino Mountain, California, extending from the summit of the Cajon Pass to the Mohave River, a distance of 19 miles, with a grade, or ascent, of about 105 feet per mile. It is traversed by the old Spanish Trail and seems like a plain to the traveler when riding in a Pullman car.

In the region of Tucson, Arizona, there are fine examples of long slopes of great regularity flanking the Santa Catalina Mountains, the Santa Ritas and the Sierritas.

The length downward of the Santa Catalina slope on the south side, measured from the 3,500-foot contour down to the Rillito, or to the 2,500-foot contour, is five miles, and the difference of elevation is 1,000 feet, giving a fall of 200 feet to the mile. This slope may be regarded as the upper portion of the former slope, the lower portion having been swept away by the Rillito and Santa Cruz drainage. If, as we may believe, the slope originally extended as far as the Santa Cruz River, or ten miles in length, the average fall would be 100 feet per mile, thus agreeing with the grade at the Sierritas Slope, and at the Santa Rita western slope.

This western flanking slope of the Santa Rita mountains is a good example of the regularity of descent, and of continuity. From the 4,000-foot contour near McCleary's camp down to the 3,000-foot contour above the Santa Cruz river, the distance is eight miles, and the fall is 1,000 feet, or about 125 feet to the mile; but if the lower portion of this slope had not been cut away by the river the length would be ten miles, and the average grade 100 feet to the mile.

The slope of the Sierritas range, southeast of Tucson, is remarkable for its average grade of about 100 feet to the mile for the distance of ten miles. The grade increases nearer the mountains in this as in other examples.

The north side slope of the same range is equally or more remarkable for its extent and even grade.

The valley of the Sonoita from Calabasas eastwards to the summit affords fine examples of the ancient slopes and their deep erosion by the river, leaving terraced banks.

Origin of Detrital Slopes.—The form and origin of detrital slopes, especially those of the southern portion of the Great Basin, are discussed in my report of Explorations in 1853.[1] The broad general molding of the slopes by oceanic action is there recognized as, also, the present modifying action of streams and flood-waters, which are described as spreading out over the lower portions of the slopes 'fan-like' in a multitude of channels, but at lower levels than the upper portions of the slopes which are cut through and left high above the existing stream. Such slopes are in strong contrast with the localized phenomena of modern deltaic detrital deposits at the mouths of mountain gorges or canyons, known as 'alluvial fans' or 'alluvial cones.' While doubtless such delta-like deposits, and the long slopes, have initially the same origin in this respect, at least, that all are made up of débris from the high rocky ridges; the flanking slopes to which I wish to direct attention are less localized, are without the deltaic form, are much more extensive and broader, and are generally without evident relation to any particular canyon or gorge of the mountain, and do not exhibit the scalloped outline of intersection claimed for alluvial fans. They show the operation of a widely extended distributing or leveling agency which it would appear could not have been other than tides, waves

[1] 'Report of a Geological Reconnaissance in California,' 1855, pp. 214–217.

and currents of the ocean during submergence of the land.

But these views of the subaqueous distribution of the detritus have not found favor and are not accepted. The consensus of geologic opinion appears to be that the slopes are wholly subaerial in origin; the result of stream action and distribution alone, without oceanic aid. Their continuity is explained by Gilbert and others, by their contiguity and the coalescence of many adjoining alluvial cones, each with its apex at the mouth of a gorge or a canyon, producing about the mouth of such gorge a symmetric heap of alluvium. Gilbert writes:

> Rarely these cones stand so far apart as to be completely individual and distinct, but usually the parent gorges are so thickly set along the mountain front that the cones are more or less united, and give to the contour of the mountain base a scalloped outline.

This view was accepted by Russell, who quotes it in his paper, in the *Geological Magazine*.[2]

It is accepted also, by Geikie, Dana and others.

In geological literature the slopes are usually described as alluvial fans, alluvial cones, or talus fans. We are indebted for most of these terms to Dr. Drew, who, describing the alluvial and lacustrine deposits and glacial records of the Upper Indus Basin, uses the terms 'fan talus' and 'alluvial fans' for the detrital accumulations at the mouths of canyons. In the illustrations these accumulations of detrital material are represented as local and very steep in inclination, with radii perhaps a mile in length. The 'amalgamation' or union of fans is recognized, and examples are given of the denudation of fan slopes.[3]

Dr. Ida H. Ogilvie, describing the topography of the Ortiz Laccolith in New Mexico, proposes the name 'conoplain' because of the outward slope of the surface in all directions.

[2] *Geological Magazine*, N. S., Decade III., Vol. VI., No. VII., July, 1889, p. 290.

[3] Frederic Drew, Esq., LL.D., F.G.S., *Quarterly Journal*, Geological Society of London, 1873, p. 441.

This sloping[4] surface is regarded as the result of subaerial stream action, under substantially present conditions, and it is suggested that the broad areas of the great plateaus have been produced by a similar process.

Evidences of Submergence.—The great dominant fact showing that the slopes in their original integrity of form were deposited and shaped during submergence, and that they were molded by oceanic currents, rather than by the waters such as now exist, is that the slopes, or the portions to which I refer, are older than the streams. They antedate the streams and the valleys of the existing drainage. The conditions under which the continuous higher slopes were formed are obviously very different from those now existing. The action of the streams of the present is one of redistribution of the material of the slopes. It is destructive of the higher and older slopes, and not upbuilding or constructive except at lower levels of deposition. It is true that the materials of portions of the slope are carried downwards and onwards and are deposited at lower levels, where the volume of water is diminished by wider distribution and by absorption. We thus have what may be called primary and secondary slopes or, if preferable, initial and derived slopes. The secondary slopes, now forming, are in washes and arroyos below the surface of the primary slopes, remnants of which are left on each side sufficient to preserve the grand topographic features and scenic effects far above the reach of modern floods. The higher parts of the flanking slopes do not to-day receive accessions from the canyons, they are not being built higher and are not the product of modern streams. The conditions of deposition were evidently very different from those of to-day. The phenomena all point to the formation of the primary slopes during a period of subsidence before the great Post-Miocene continental uplift. The amplitude of this movement was doubtless greater than is indicated by the height of the initial slopes.

Generally throughout the southwest, the upper margin of the slopes is between the

[4] *American Geologist*, Vol. XXXVI., July, 1905.

3,000 and 5,000-foot contour line. The upper margin of the slopes of the mountains of the southern part of the Great Basin has an average height of 3,466 feet, the mean of the height at eight different localities ranging from 3,000 to 4,000 feet.

The Santa Catalina range of mountains north of Tucson affords an excellent example, especially along the south side, where, for a distance of nearly fifteen miles, the slope commences at the base of the cliffs at about the contour line of 3,000 feet. The change of the topography may be followed by the eye. It has the semblance by its horizontality of a beach line or old shore line, but the usual characteristics of an old beach or ocean border, such as shingle and upright sea-wrought cliffs, are wanting, having probably been obliterated by long-continued weathering. The same contour line of 3,500 feet may be followed similarly around the western point of the range to the north side. In other words, the 3,500-foot contour line follows approximately the beginning of the rocky outcrops above and of the slopes below. From this elevation up to 4,000 feet appears to have been the height of the old ocean level for a long time. It can not yet be fixed with precision. Careful search along this general level may result in finding unequivocal evidence of the former level of the sea. In the Huachuca Mountains the upper margin of the slopes is higher, being nearer the 5,000-foot contour than the 3,000-foot.

We do not find along the Catalina range, a distinctly scalloped outline of intersection of the slope with the higher ridges. The slope is very even and regular in its continuity and in the approximate parallelism of the contour lines, broken only by the arroyos or channels of modern drainage, leaving remnants of the former slope on each side. The same observation applies to the slopes bordering the Santa Rita and other ranges north and south of Tucson. These conditions are well illustrated by the contour lines on the map by the U. S. Geological Survey of the Tucson and Santa Rita quadrangles to which reference is made.

Slopes Older than Existing Drainage.—That these ancient detrital slopes are older than the present streams and watercourses is made more evident and in a striking manner by the fact that existing streams and valleys cut across the slopes at right angles to their line of descent, in some instances bisecting the slopes as on the San Pedro River, between its junction with the Gila river and the town of Mammoth. One part of the long slope from the Catalinas is found on one side of the stream, and another portion on the opposite side.

The slope of the southern side of the Santa Catalina, a few miles north of Tucson, is cut across for miles at right angles to its southward descent by the east and west stream, known as the Rillito, which has left an abrupt bank on its north or right bank, a truncation of the slope, while on the south side or left bank we find upon the 'mesa' the coarse detrital deposits characteristic of the 'wash' or slopes of the Catalinas. It is clear that these deposits were once continuous and that they were laid down before the Rillito valley was cut out. Semi-rounded blocks of large size, a foot or more in diameter, of the peculiar augen-gneiss of the Catalina ridges, and horizontal beds of gravel and sand from the mountains are found in digging the wells of the mesa south of the Rillito. Obviously this distinctly detrital slope was formerly unbroken in its extension to the Santa Cruz, and was formed before the Rillito valley, which has been cut out of the slope by the river.

Similar conditions are found farther south where the Santa Cruz River cuts across the lower portion of the slope from the Santa Rita mountains, north and south of Tubac. The cutting out of this valley leaves a steep bluff-like ending of the long regular slope. This also has many deep arroyos parallel to the line of descent, which show the rude stratification of the detrital materials of the slope, portions of which are soft and clay-like, apparently deposited under water. In some sections, the stratification is very regular and horizontal. The portions of the ancient slope left between the arroyos have practically the same angle of descent and the

same elevation and are clearly remnants of a once continuous slope or inclined plane.

Antiquity of the Slopes.—In further support of the view of the great geological antiquity or Tertiary age of the initial slopes, reference may be made to the high auriferous gravels of the Sierra Nevada of California, which probably were coincident in formation. Like the ancient detrital slopes of Arizona, they are cut through in all directions by existing rivers. Their great antiquity is undoubted, and is generally regarded as late Tertiary. Russell, in his Quaternary History of the Mono Basin[5] (1889) records his opinion that the excavation of many of the valleys of the Sierra Nevada began long previous to the Quaternary, and are, in fact, relics of a drainage system which antedates the existence of the Sierra as a prominent mountain range.

The detrital slopes of the mountains around the ancient lake Bonneville were found by Gilbert to be older than the lake deposits and to extend below the old shore lines and lighter deposits of the lake. He writes:

> The alluvial cones do not find their bases at the level of upper shore lines, but extend downward continuously to the bottom of the valleys, while the shore-lines are wrapped about them.[6]

So, also, Russell found similar conditions at Lake La Hontan. He uses the term 'alluvial slopes."

Turner, following Russell, has recognized the early Pleistocene or Sierran age of a portion of the materials filling the Great Valley of California and of portions of the alluvial fans of the Great Basin.[8]

Red Earth Deposits.—Upon the surface of the flanking slopes of the southwest, the earth is sandy and gravelly, and there is a general absence of vegetable mold or soil containing humus.

The presence of a large amount of red earth in many places is a notable fact, especially as it is more or less argillaceous, stratiform, and interstratified with coarse gravelly layers. It is found in quantity in some of the sections of the general slope, exposed by erosion of surface waters. At the northern end of the Santa Catalinas, red earth constitutes a large part of the upper slope at about 4,000 feet altitude. It is there largely in terrace form and is suggestive of the red-clay formation of the ancient Lake Quiberis in the valley of the San Pedro, evidently an ancient estuary, or landlocked valley; a good evidence of former submergence.

Conclusion.—If it is objected to these views of the origin of the broad slopes under water that we do not find strongly marked sea-cliffs and beach-shingle in connection with the slopes, an explanation may be found in a gradual but continuous uplift, so that all accumulations of shingle were leveled off by the retreating water. And in regard to the shore lines, if any were sculptured, the great antiquity of the formation has permitted their effacement.

The absence, so far as known, of any marine remains is readily accounted for by the earthy and gravelly nature of the detritus, its rapid formation and its constant disturbance by the tides and ocean currents, preventing the local development of marine life.

William P. Blake
University of Arizona

[5] Eighth Annual Report, U. S. Geological Survey, p. 350.

[6] 'Contributions to History of Lake Bonneville,' Second Annual Report, U. S. Geological Survey, p. 184.

[7] Israel Cook Russell, 'Geological History of Lake La Hontan.'

[8] 'Origin of the Yosemite Valley,' *California Acad.*, Vol. I., No. 9, p. 269, 1900.

QUOTATIONS

The Presidency of the Massachusetts Institute of Technology

The difficulties of the Massachusetts Institute of Technology in finding a president are deserving of more than local interest. President Eliot remarked in substance to one of the trustees recently, "You offered the place to a Latin professor and he declined, and now I see that you have offered it to a professor of Greek," an observation suggesting that for a school of theoretical and applied science the institute does not object to going considerably afield in its search for a president. The trustees answer, however, that the great college administrator is the great president, and that

it is relatively immaterial which branch of higher learning he may make his specialty.

President Benjamin Ide Wheeler, of the University of California, does not at present intend to accept the position. In the strictest sense he has never been formally offered it, but he did agree, in response to the request of the committee, to come here and talk with the members concerning it. Were he willing to accept the place it would be pressed upon him, an arrangement which amounts to about the same thing as a formal tender. Presidents of state universities are becoming increasingly aware of the advantage that they possess in being freed from the necessity of 'begging,' except, of course, from the single source to which they regularly go for funds. Seeking pecuniary aid among friends of an institution is not an agreeable task. This part of the Boston work is believed to be quite as responsible for Dr. Wheeler's present state of mind as anything else, although he in addition realizes his personal unfamiliarity with a considerable range of the institute's educational interests.

Dr. Pritchett, who resigned the presidency a year and a half ago, and has since been carrying on the leadership of the institute while attending to his other duties, thus shouldering a very heavy responsibility, will definitely terminate his work on his departure for his vacation this summer. It is hardly likely that any serious attempt will be made to secure a president between now and that time, but instead a member of the faculty, or perhaps of the executive committee, will be designated as acting president, to carry on the work until the place can be formally filled. Dartmouth College will be next year in the field looking for a president, too. Increasingly difficult it seems to be in the present complexity of university affairs to get the right men for positions of this character.—The Boston *Transcript*.

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

MEISSNER'S 'METEOROLOGISCHE ELEMENTE'

A RECENT book by Otto Meissner, published in the 'Sammlung naturwissenschaftlich-paedagogischer Abhandlungen,' deals with the most essential facts of meteorology in a clear and simple way. The full title of the volume is "Die Meteorologische Elemente und ihre Beobachtung, mit Ausblicken auf Witterungskunde und Klimalehre. Unterlagen für Schulgemässe Behandlung sowie zum Selbstunterricht." The publisher is Teubner (Berlin, 1906, 8vo, pp. 94, figs. 33). The object of this new book, as stated in the title, is to promote meteorological instruction in schools and, by treating the subject in an elementary way, to make it possible for the reader to instruct himself. Special emphasis is laid, in the final chapter, on the relations between the meteorological elements and organic life, and the simple rules for weather forecasting are adapted to the use of individual observers who wish to make local forecasts. The origin of important technical terms is indicated in foot-notes. Meissner's little volume is hardly adapted for use in teaching systematic meteorology—it is too disjointed and too superficial for that—but there are numerous suggestions and illustrations which are not found in other books on the same subject. We regret the wholly inadequate statement as to the deflective force of the earth's rotation (p. 39), which gives the impression that north and south winds only are deflected, although later paragraphs state that Ferrel's Law acts in the case of all winds. We note (p. 42) that the anti-trades are stated 'wenigstens teilweise' to descend at the Horse Latitudes, in accordance with Hildebrandsson's view. Undue emphasis is laid (p. 52) on the effect of dust in promoting condensation, no mention being included of the effect of ionization. And it appears (p. 89) as if the effect of deforestation and reforestation were much greater than the best observations lead us to think. Finally we observe one misprint, and a bad one at that. On page 90 Hann is spelt *Hamm*—and that in a meteorological textbook.

'INTERNATIONALER METEOROLOGISCHER KODEX'

AN official 'Internationaler Meteorologischer Kodex' has been prepared by Drs. Hellmann and Hildebrandsson (large 8vo, Berlin,

Behrend and Co., 1907, pp. 81), in which the resolutions passed at the successive meetings of the International Meteorological Congress and of the International Meteorological Committee are systematically classified by subjects, with references to the meetings at which they were adopted, and to the publications in which the discussions on these resolutions may be found. Hitherto it has been difficult, without a considerable expenditure of time, to ascertain exactly what the official action has been in reference to the numerous subjects which have been considered at these meetings. Dr. Hellmann proposed the preparation of this *Kodex* at the Southport meeting of the International Meteorological Committee in 1903, and the volume has now been published in accordance with the authorization given to Drs. Hellmann and Hildebrandsson by the committee. Resolutions covering matters which have been disposed of (*e. g.*, the international cloud year) are omitted, as are those which have been superseded by later votes. A very full index (subject and author) to the reports of the international meteorological meetings is appended to the *Kodex*, and adds greatly to the value of the work done at these important gatherings. The *Kodex* is not a book for general reading, but it would be well for writers of future text-books on meteorology and climatology to study it carefully, in order to give their readers the official opinion on such matters as the exposure and corrections of instruments; the hours and methods of observation, etc.

R. DeC. Ward

Harvard University

ACADEMIC SALARIES

Mr. Edward M. Shepard, the eminent lawyer and statesman, has addressed the following letter to the editor of the New York *Times:*

The 'Taxpayer' who has made by letter to you an attack upon the purchase of a house to be occupied by the president of the College of the City of New York, would have done better to have ascertained the facts before making anonymous criticism. There is no intention whatever to donate a house to President Finley. The college, for the purposes of the more efficient performance of its work, already great, with its 4,000 students, and fast becoming greater, is to acquire a house close to its buildings to be used by President Finley so long as the college and the city are fortunate enough to enjoy the enormous advantage of his very able and high-minded administration, and, when that good fortune of the college and the city shall end (may the Greek Kalends come first) President Finley's successor will occupy the house.

The city itself acquires the house, without suggestion or hint from President Finley, as an economical method of making some part of a suitable increase to the compensation of the President (now $8,250) and as a means to facilitate the performance of his many and varied duties. Even with the rent of a house, his salary will be less than that of any one of the police magistrates of the city or any one of the civil magistrates of the city; it will be less than three fifths the salary of any one of the supreme court justices. Yet every well-informed citizen knows that, in difficulty of his work and in its supreme importance to the general welfare of the city, President Finley's place is not surpassed by that of any judge, or, indeed, by any in the city, unless, perhaps, the places of the mayor, the controler and one or two others.

The plain fact is, and your correspondent 'Taxpayer' may take notice of it, that, even with the increase in salary which this house will provide President Finley, his salary and the salaries of the professors of the college are inadequate and not in fit proportion to the salaries at Columbia University or the High Schools and public schools. The Normal College recently extended an invitation to a distinguished educator to become its president at a salary $2,000 greater than the salary of President Finley will be when enlarged by the rent of his house. The president and professors receive the same salaries which they had very many years ago. The professors' salaries ($4,750) are to-day what they were thirty or thirty-five years ago; while the salaries of all other teachers and professors and of all others in the service of the city have been largely increased, and living expenses at New York have enormously increased.

I do not know the view of my associate trustees, but I shall ask them to submit to the Board of Estimate next fall a proposal to increase the salaries of the professors of the college, and, per-

haps, to still further increase the salary of the president. Nor shall I object to the attendance of 'Taxpayer' before the Board of Estimate to oppose, if he see fit, but there in the open that we may know what interest he represents.

EDWARD M. SHEPARD,
Chairman Board of Trustees, College of the City of New York
NEW YORK,
June 10, 1907

SCIENTIFIC NOTES AND NEWS

PRINCETON UNIVERSITY has conferred its doctorate of laws on President Alexander Humphreys, of the Stevens Institute of Technology, and Dr. Edward G. Janeway, professor of medicine and dean of the University and Bellevue Hospital Medical College.

COLUMBIA UNIVERSITY has conferred the doctorate of laws on Dr. Elmer E. Brown, U. S. commissioner of education, and on Dr. Henry F. Osborn, Da Costa professor of zoology in the university and curator of vertebrate paleontology in the American Museum of Natural History.

AT the recent meeting of the American Medical Association at Atlantic City officers were elected as follows: *President,* Dr. Herbert L. Burrell, Boston; *first vice-president,* Dr. Edwin Walker, Evansville, Ind.; *second vice-president,* Dr. Hiram R. Burton, Lewes, Del.; *third vice-president,* Dr. George W. Crile, Cleveland; *fourth vice-president,* Dr. J. Blair Stewart, Atlantic City; *secretary,* Dr. George H. Simmons, Chicago; *treasurer,* Dr. Frank Billings, Chicago. Drs. T. J. Happel, Trenton, Tennessee, W. W. Grant, Denver, and Philip Marvel were reelected to the board of trustees.

DR. THOMAS E. DAVIS, of Pittsburg, has been elected president of the American Academy of Medicine.

AIDED by another grant from the Hodgkins Fund, held by the Smithsonian Institution, Professor A. Lawrence Rotch, director of the Blue Hill Observatory, will execute at St. Louis a sixth series of experiments with *ballons-sondes* next October, a season when observations at great heights in the free air are lacking in America.

DR. FRANK M. ANDREWS, who has been promoted to an associate professorship of botany at the University of Indiana, has been given leave of absence, and will spend the coming year at the German universities and the Naples Zoological Station.

DR. N. A. COBB, formerly pathologist to the government of New South Wales, Australia, more recently director of the division of pathology and physiology, Sugar Planters' Experiment Station, Honolulu, Hawaii, is now connected with the Bureau of Plant Industry, Department of Agriculture, Washington, D. C.

MR. H. A. BUEHLER, assistant state geologist of Missouri, has resigned to engage in professional work. His resignation will take effect on July 1, 1907. Mr. Buehler's successor has not been selected.

PROFESSOR CHARLES N. GOULD, of Norman, Oklahoma, reports the discovery, in the Arbuckle Mountains, of immense deposits of glass sand. Analyses made in the laboratories of the State University of Oklahoma indicate that the sand is more than 99 per cent. pure silica with no trace of iron. The discovery of this sand so near the extensive gas fields now being developed in that region is a matter of economic as well as of scientific interest.

ASSISTANT PROFESSOR GEORGE A. REISNER, now on leave of absence from Harvard University during archeological investigations in Palestine and Egypt, has been appointed by the Egyptian government archeologist-in-charge of the government excavations which are being commenced in the Nile Valley to the south of Aswan. The work will consist essentially in carrying out the excavations necessary to insure the thorough subterranean examination of that portion of the territory which will be submerged by the Aswan Reservoir when at its full height of 113 meters above sea level.

AT a meeting of the Jackson County Medical Society, held in Jefferson, Ga., on April 10, a monument to the memory of Dr. Crawford W. Long was presented by the society to the city of Jefferson and Jackson County.

The monument is to be erected on the spot where Dr. Long first performed a surgical operation under anesthesia.

Professor Alfred Newton, F.R.S., who held the chair of zoology and comparative anatomy at Cambridge and eminent as an ornithologist, has died at the age of seventy-eight years.

Dr. Edward John Routh, F.R.S., the eminent mathematician of the University of Cambridge, died on June 7, at the age of seventy-six years. Dr. Routh made important contributions to mathematics, but was best known as a coach. From 1861 to 1885, with the single exception of 1883, the senior wrangler each year was one of his pupils, besides twice before that date and once afterwards—in all twenty-seven times. In the thirty-one years of his teaching career, from 1857 to 1888, he coached nearly seven hundred young men through the mathematical tripos, of whom more than five hundred took rank as wranglers.

Dr. Maxwell Tylden Masters, F.R.S., the well-known English botanist, from 1866 to the time of his death editor of *The Gardeners' Chronicle,* died on May 30, at the age of seventy-four years.

We learn from *Nature* that a special meeting of the proprietors of the London Institution, Finsbury Circus, was held on May 8 to consider a proposed scheme of rebuilding, having for its objects "such an increase of revenue as would enable the committee to carry out the objects of the charter on a wider basis than at present, and at the same time to give improved accommodation to the proprietors." The scheme provides for the removal of the present lecture theater and smoking room, thus rendering vacant 10,612 superficial feet of land, to be let on a building lease for eighty or ninety years. The alterations would include a new theater, a storage room for 200,000 volumes, refreshment and other rooms, and the dividing of the present reference library into a reading room, small lecture room and a committee room. The cost is estimated to be about £15,600. Strong criticism of the scheme led to the adjournment of the meeting for four weeks.

The Cardiff public telescope and observatory are proving a decided success. During the last few weeks, in response to an appeal from Mr. Albert Taylor, a large number of teachers in the locality have applied for permission to use the instrument. The attendance of the general public also has been such as quite to warrant the corporation in the expense to which it went in connection with the observatory.

The Electrical World says: It is stated that so unprofitable have the insurance companies found risks on college buildings that there is prospect of a general increase in rates. The entire May issue of *Insurance Engineering* is devoted to an analysis of school and college conditions. From reports of 322 institutions the editor says: "We learn the lesson from the schools and colleges that precautions against fire have been generally neglected." In eighteen years the figures gathered show that 784 fires in college buildings have caused a loss of $10,500,000 and a heavy loss of life. The average money loss has exceeded $13,300.

Last autumn Mr. A. Trevor-Battye made a tour on the Continent, and visited the principal zoological gardens of Holland, Germany and Austria for the purpose of observing the houses, cages and enclosures, and comparing them with those in the Regent's-park Gardens. Recently at the scientific meeting of the Zoological Society, he embodied his results in a paper, which was illustrated by a series of official plans and diagrams. According to the London *Times* two points specially impressed him—the care given to the preparations of plans of a house as part of a general scheme, and the tendency to get rid, so far as it could be done with safety, of bars and wiring. As prominent examples he cited the fine masses of rockwork for wild sheep and goats and the rocky areas for lions and tigers, separated from the spectators by a wide ditch, hidden by greenery, at Carl Hagenbeck's Tierpark at Stellingen. The method of shifting ostriches from the house to the paddocks in use at Hamburg was commended, as was the house

for small rodents at Berlin, where the animals are seen burrowing, separated by glass from the visitors. A full description was given of the monkey-house, where the anthropoids are also kept, at Rotterdam, and the details were explained by means of the working plan; and other places selected for praise in the garden were the stores, workshops, and infirmary for sick animals. The monkey-houses at Breslau and Berlin were referred to as showing how the difficulty of access to the open from central cages was got over by a passage the doors in which could be opened by the animals. The fine new block-house for deer at Breslau was mentioned as one of the best in Europe. In conclusion Mr. Trevor-Battye referred to the greater use of glass on the Continent for the protection of the animals, to the supply of water to bears other than the Polar species, and the better arrangements for lighting, and said that when one considered the conditions governing gardens in Great Britain the wonder was, not that they should be surpassed in some points, but that they should be carried on half so well.

A FRIDAY evening lecture at the Royal Institution was given recently by Sir James Crichton Browne, on 'Dexterity and the Bend Sinister.' According to the report in the London *Times* he said that during the last 2,000 years there had been innumerable eruptions of ambidextral enthusiasm, and some five years ago a new crusade on behalf of ambidexterity had been started. He held, however, that on the large scale ambidexterity was impossible and undesirable, that it was by the superior skill of his right hand that man had got himself the victory, and that to try to undo his dextral preeminence was simply to fly in the face of evolution. Right-handedness was a very old story; it was plainly discernible in the art of Greece, Assyria and Egypt, glimpses of it could be found among our ancestors in the Bronze age and in Paleolithic times, and some observers had detected foreshadowings of it even among the lower animals. All nations, tribes and races, civilized and savage, had in all times preferentially used not only one, but the same hand, and it was impossible to point to any civilized race manifesting any degree of either-handedness; the statement that the Japanese were by law and practise ambidextrous, he could say, on the authority of Baron Komura, was without foundation. It was doubtful, indeed, whether, strictly speaking, complete ambidexterity existed in any fully developed and civilized human beings, though sometimes very close approximations to it occurred; but among microcephalic idiots, in whom the small headedness was due to arrested development, left-handedness and ambidexterity had been found to reach a proportion as high as 50 per cent. The source of right-handedness was much deeper than voluntary selection, and must be sought in anatomical configuration—in the structure and organization of the brain that initiated, directed and controlled all voluntary movements. The brain had two hemispheres, of which the right presided over the left side of the body, and the left over the right side, and it was clear that functional differences in the two hands were in some way connected with differences in the two hemispheres—differences not of weight or blood supply, as had been suggested by some inquirers, but of convolutional development. Study of the speech center in the third frontal or Broca's convolution had thrown a flood of light on the subject of right-handedness, for it had shown that damage to this convolution in the left hemisphere deprived the right-handed man of speech, but left the left-handed man with speech unimpaired, while in the left-handed man the contrary held good. Here, then, there was one-sidedness of the brain, assuredly not due to use and wont, or to any acquired habit or mechanical advantage. But the hand and arm centers in the brain were intimately linked with the speech centers, and therefore it was only logical to infer that the preferential use of the right arm and hand in voluntary movements was also due to the leading part taken by the left hemisphere. We could not, he believed, get rid of our right-handedness, try how we might. It was woven in the brain; to change the pattern the tissues must be unravelled. Ambidextral culture, useful

enough in respect of some few special movements in some few specially employed persons, must on the large scale tend to confusion; and pushed towards that consummation which its ardent apostles said was so devoutly to be wished for, when the two hands would be able to write on two different subjects at the same time, it must involve the enormous enlargement of our already overgrown lunatic asylums.

UNIVERSITY AND EDUCATIONAL NEWS

The Michigan Legislature on June 13 passed the bill increasing the appropriation for the University of Michigan from a one quarter mill tax to a three eighths mill tax.

The Mackay School of Mines is the name given to the department in the University of Nevada endowed by Mr. Clarence H. Mackay. Mr. Mackay has given money for a building and $120,000 for endowment.

Mrs. John Hay, widow of the former secretary of state, and her sister, Mrs. Samuel Mather, have given Adelbert College, Cleveland, a memorial chapel in the memory of their father, Amasa Stone. Adelbert College was named after Mrs. Hay's brother, Adelbert Stone.

Medical journals state that it is planned to rebuild the medical building of McGill University, which was recently destroyed by fire, on a plot of ground immediately opposite the Royal Victoria Hospital. The ground is owned by Lord Strathcona, who bought it for the purpose of preventing residences being built opposite the hospital, and who is believed to be willing to place it at the disposal of the university. The laboratory, which practically escaped the flames, will remain where it is, but the plot on which the medical building proper stood will be cleared and left for the general beautification of the grounds.

The Carnegie Building and the Walker Chemical Laboratory of the Rensselaer Polytechnic Institute were dedicated on June 12. The addresses were made by Mr. Emil Swensson and Dr. William McMurtrie. The address in connection with the conferring of degrees was made by Dr. W. H. Wiley.

The University of Wisconsin will this year give 476 baccalaureate and 49 higher degrees.

The New York *Medical Record* states that at a recent meeting of the board of supervisors of the Louisiana State University, held in Baton Rouge, the charter and by-laws of the new medical college of the university, to be established in New Orleans, and the contract of assimilation between the university and the medical department were submitted to the supervisors and approved. It is the general understanding that this medical department is to be ready for opening during 1908.

During the past year the students in the department of geology at the University of Michigan have increased from 124 to 281. The regents of the university have met the demand for a larger instructional staff by making the following new appointments: E. C. Case, Ph.D., assistant professor of historical geology and paleontology; I. D. Scott, A.M., instructor in geology; L. P. R. Willoughby and W. E. Bliss, assistants in geology. An appropriation has also been made to equip an earthquake station at the university.

George V. Wendell, associate professor of physics at the Massachusetts Institute of Technology, has been appointed head of the physics department in Stevens Institute of Technology.

Mr. Francis J. Seery has been promoted to an assistant professorship of civil engineering at Cornell University.

Dr. William Salant, of the department of biological chemistry of Columbia University, has accepted an appointment to the position of adjunct professor of physiological chemistry and pharmacology at the University of Alabama.

Mr. H. H. Severin, A.M., of the University of Wisconsin, and Mr. S. Morgulis, A.M., of Columbia University, have been appointed to fellowships in zoology and entomology in the Ohio State University for the year 1907–8.

Mr. A. D. Imms, of Christ's College, Cambridge, has been appointed professor of biology at Allahabad University.